FIG. 1

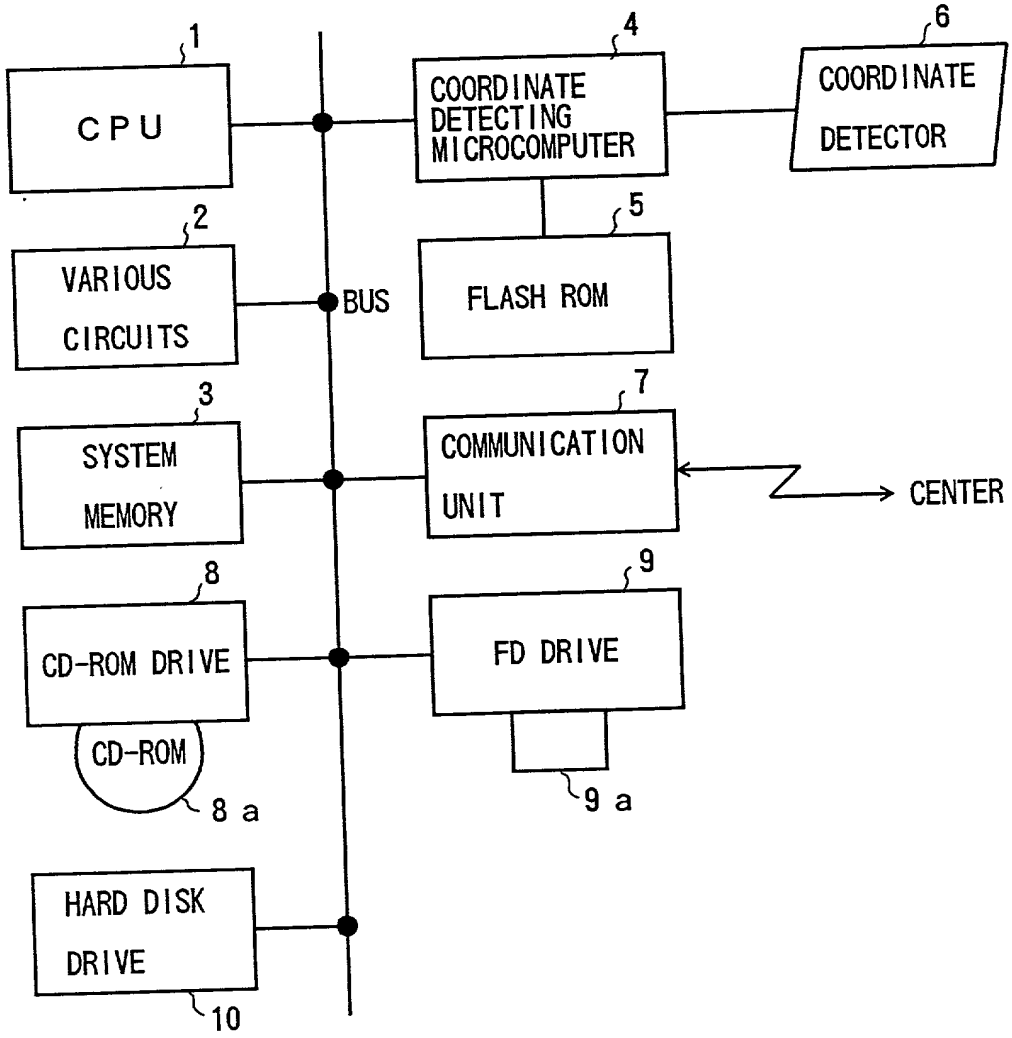
1
CPU
2
VARIOUS CIRCUITS
3
SYSTEM MEMORY
8
CD-ROM DRIVE
CD-ROM
8 a
HARD DISK DRIVE
10
BUS
4
COORDINATE DETECTING MICROCOMPUTER
5
FLASH ROM
7
COMMUNICATION UNIT
CENTER
9
FD DRIVE
9 a
6
COORDINATE DETECTOR

FIG. 2

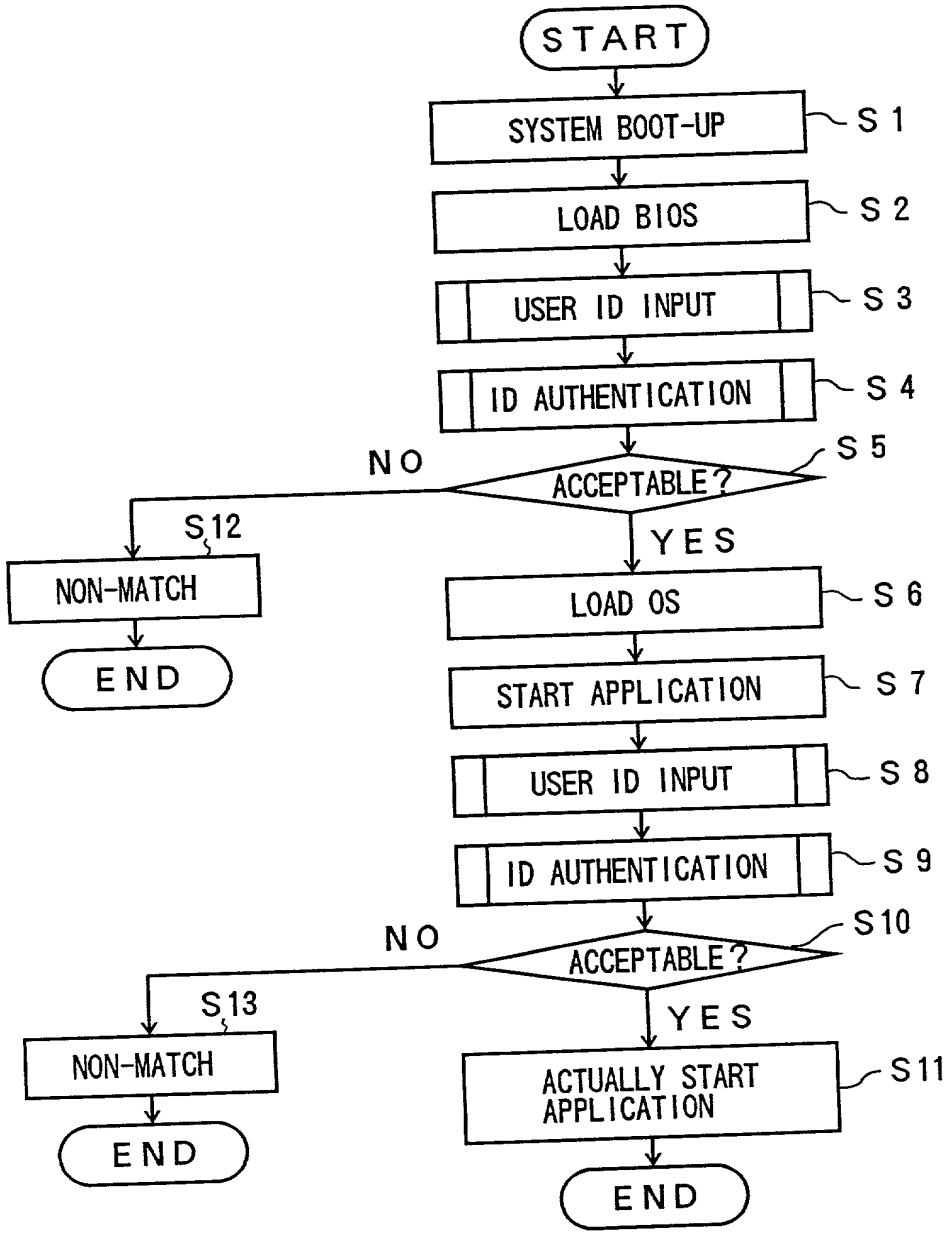
START
SYSTEM BOOT-UP
S 1
LOAD BIOS
S 2
USER ID INPUT
S 3
ID AUTHENTICATION
S 4
ACCEPTABLE?
S 5
NO
YES
S12
NON-MATCH
END
LOAD OS
S 6
START APPLICATION
S 7
USER ID INPUT
S 8
ID AUTHENTICATION
S 9
ACCEPTABLE?
S10
NO
YES
S13
NON-MATCH
END
ACTUALLY START APPLICATION
S11
END

FIG. 3

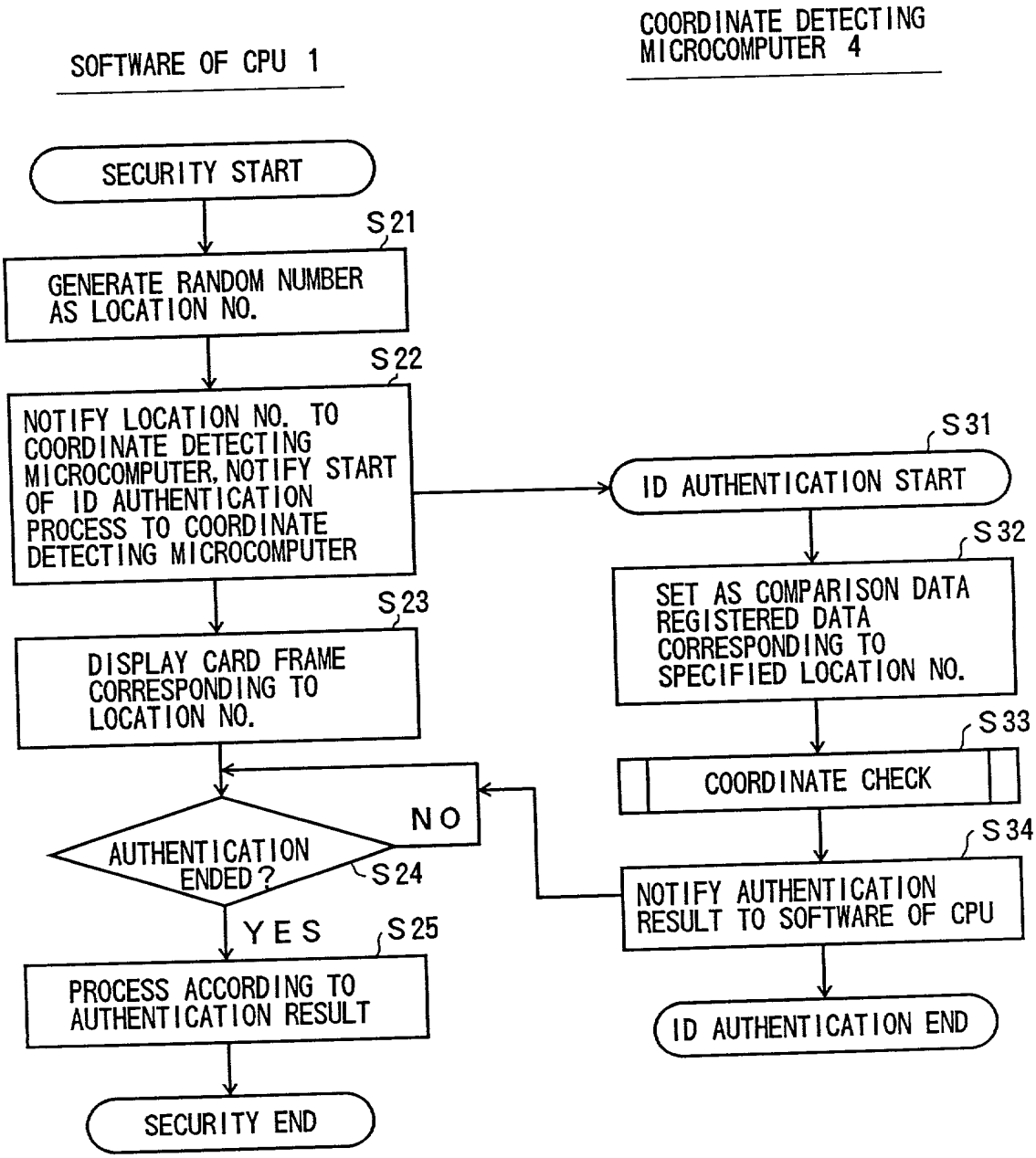
SOFTWARE OF CPU 1
COORDINATE DETECTING MICROCOMPUTER 4
SECURITY START
S21
GENERATE RANDOM NUMBER AS LOCATION NO.
S22
NOTIFY LOCATION NO. TO COORDINATE DETECTING MICROCOMPUTER, NOTIFY START OF ID AUTHENTICATION PROCESS TO COORDINATE DETECTING MICROCOMPUTER
S23
DISPLAY CARD FRAME CORRESPONDING TO LOCATION NO.
AUTHENTICATION ENDED?
S24
NO
YES
S25
PROCESS ACCORDING TO AUTHENTICATION RESULT
SECURITY END
S31
ID AUTHENTICATION START
S32
SET AS COMPARISON DATA REGISTERED DATA CORRESPONDING TO SPECIFIED LOCATION NO.
S33
COORDINATE CHECK
S34
NOTIFY AUTHENTICATION RESULT TO SOFTWARE OF CPU
ID AUTHENTICATION END

FIG. 4

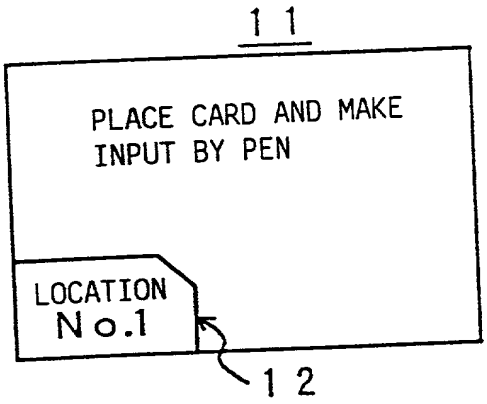

FIG. 5A

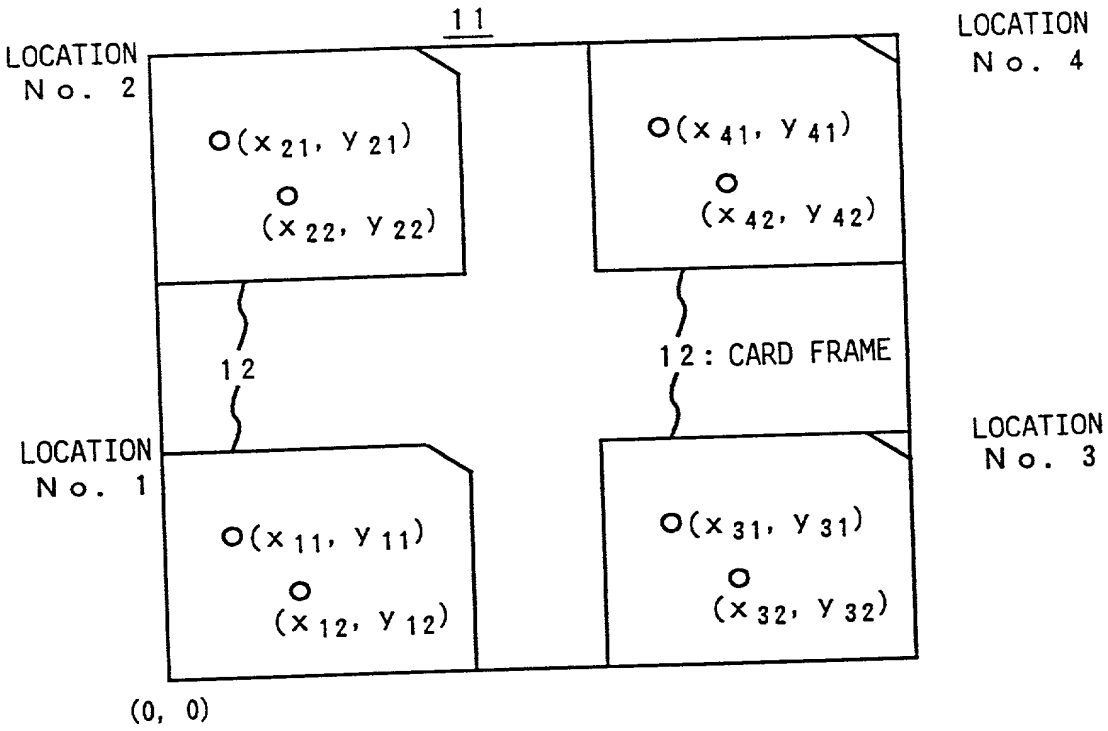

FIG. 5B

LOCATION No.	POINT No.	COORDINATE
1	1	(x_{11}, y_{11})
	2	(x_{12}, y_{12})
2	1	(x_{21}, y_{21})
	2	(x_{22}, y_{22})
3	1	(x_{31}, y_{31})
	2	(x_{32}, y_{32})
4	1	(x_{41}, y_{41})
	2	(x_{42}, y_{42})

FIG. 6A

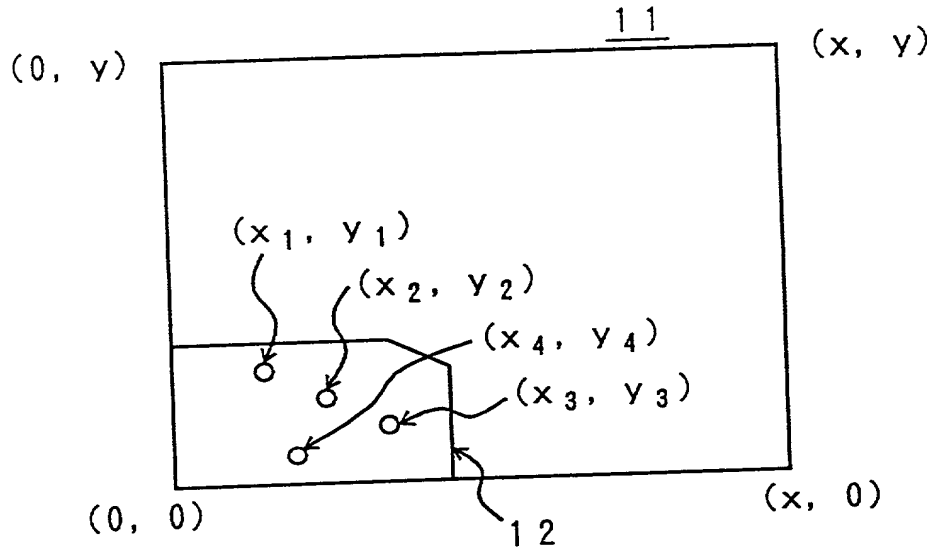

FIG. 6B

No.	COORDINATE
1	(x_1, y_1)
2	(x_2, y_2)
3	(x_3, y_3)
4	(x_4, y_4)

FIG. 7

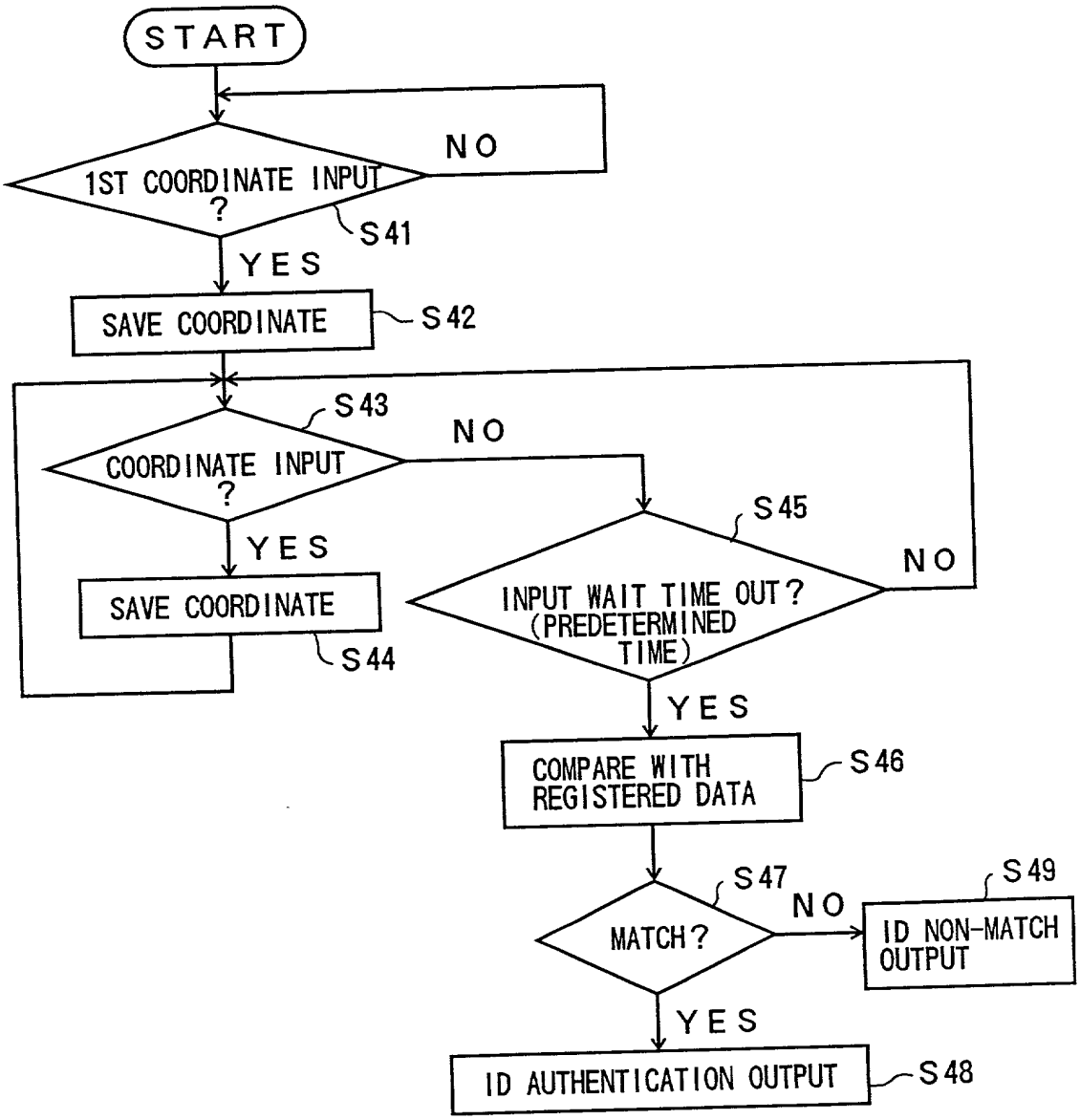
START
1ST COORDINATE INPUT ?
NO
S41
YES
SAVE COORDINATE
S42
S43
COORDINATE INPUT ?
NO
YES
SAVE COORDINATE
S44
S45
INPUT WAIT TIME OUT? (PREDETERMINED TIME)
NO
YES
COMPARE WITH REGISTERED DATA
S46
S47
MATCH?
NO
S49
ID NON-MATCH OUTPUT
YES
ID AUTHENTICATION OUTPUT
S48

FIG. 8

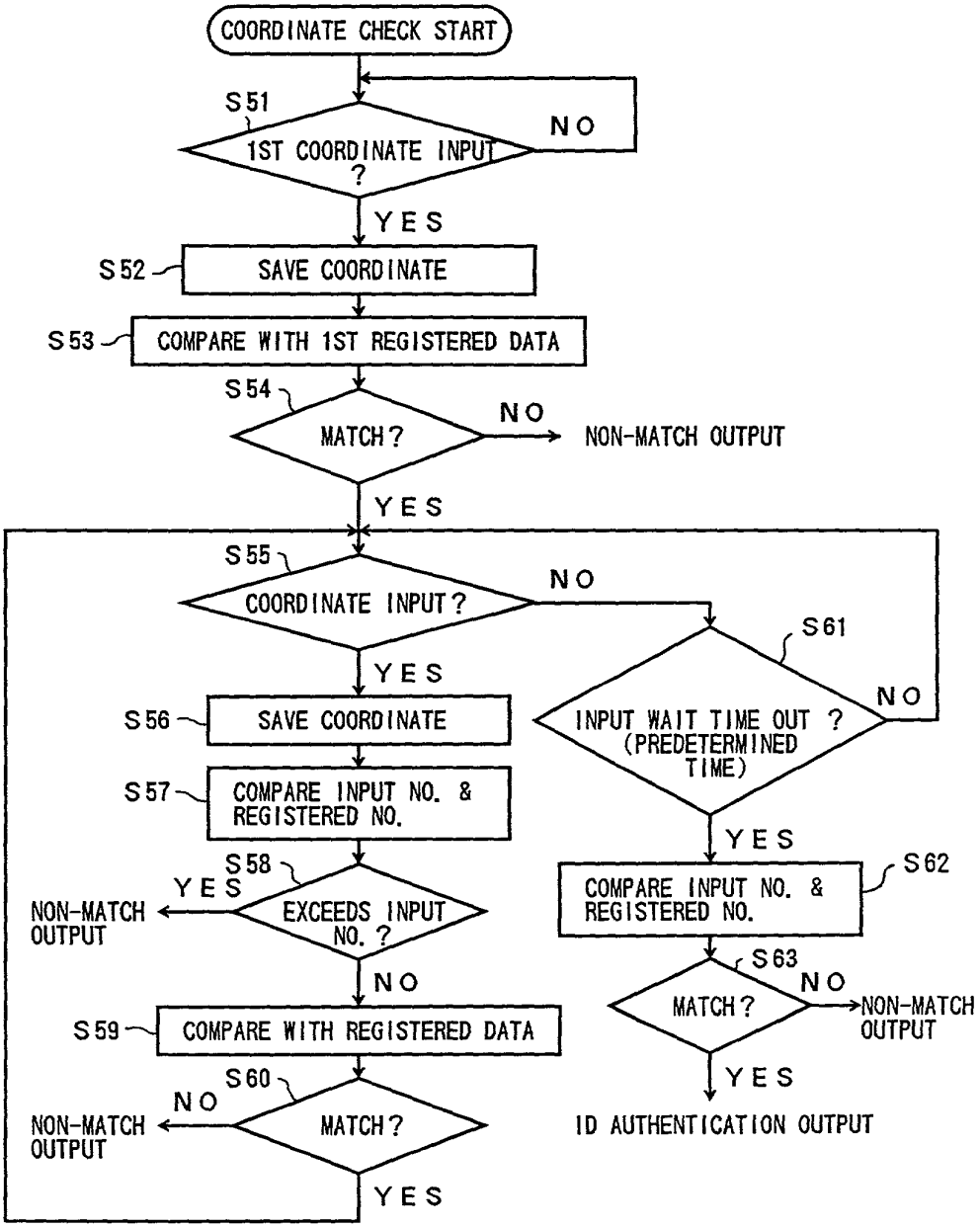
COORDINATE CHECK START
S51
1ST COORDINATE INPUT ?
NO
YES
S52
SAVE COORDINATE
S53
COMPARE WITH 1ST REGISTERED DATA
S54
MATCH?
NO
NON-MATCH OUTPUT
YES
S55
COORDINATE INPUT?
NO
YES
S56
SAVE COORDINATE
S57
COMPARE INPUT NO. & REGISTERED NO.
S58
YES
NON-MATCH OUTPUT
EXCEEDS INPUT NO. ?
NO
S59
COMPARE WITH REGISTERED DATA
S60
NO
NON-MATCH OUTPUT
MATCH?
YES
S61
INPUT WAIT TIME OUT ? (PREDETERMINED TIME)
NO
YES
S62
COMPARE INPUT NO. & REGISTERED NO.
S63
MATCH?
NO
NON-MATCH OUTPUT
YES
ID AUTHENTICATION OUTPUT

FIG. 9

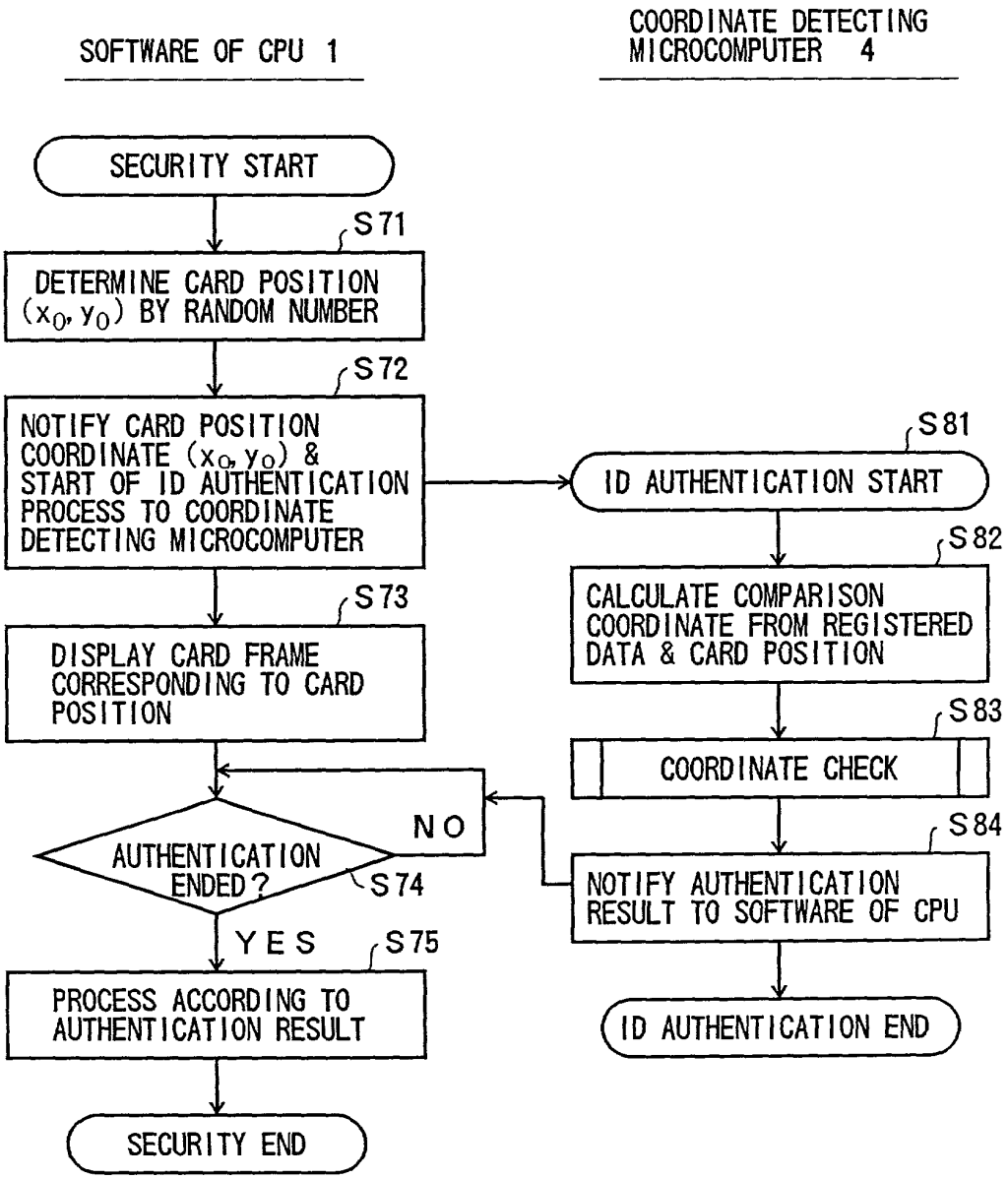
SOFTWARE OF CPU 1
COORDINATE DETECTING MICROCOMPUTER 4
SECURITY START
S71
DETERMINE CARD POSITION (x_0, y_0) BY RANDOM NUMBER
S72
NOTIFY CARD POSITION COORDINATE (x_0, y_0) & START OF ID AUTHENTICATION PROCESS TO COORDINATE DETECTING MICROCOMPUTER
S73
DISPLAY CARD FRAME CORRESPONDING TO CARD POSITION
AUTHENTICATION ENDED?
NO
S74
YES
S75
PROCESS ACCORDING TO AUTHENTICATION RESULT
SECURITY END
S81
ID AUTHENTICATION START
S82
CALCULATE COMPARISON COORDINATE FROM REGISTERED DATA & CARD POSITION
S83
COORDINATE CHECK
S84
NOTIFY AUTHENTICATION RESULT TO SOFTWARE OF CPU
ID AUTHENTICATION END

FIG. 10A

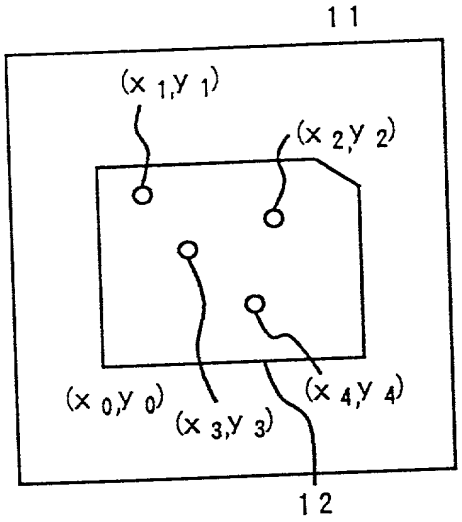

FIG. 10B

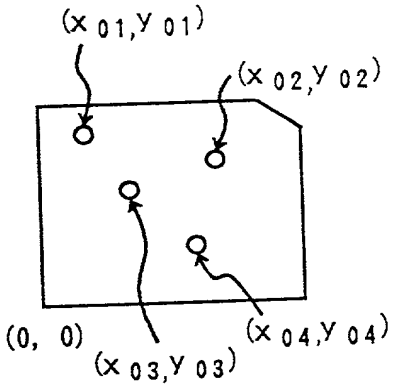

FIG. 10C

POINT No.	CARD ORIGIN	HOLE COORDINATE VALUE WITHIN CARD	COMPARISON COORDINATE
1	(x_0, y_0)	(x_{01}, y_{01})	$(x_1, y_1) = (x_0+x_{01},\ y_0+y_{01})$
2		(x_{02}, y_{02})	$(x_2, y_2) = (x_0+x_{02},\ y_0+y_{02})$
3		(x_{03}, y_{03})	$(x_3, y_3) = (x_0+x_{03},\ y_0+y_{03})$
4		(x_{04}, y_{04})	$(x_4, y_4) = (x_0+x_{04},\ y_0+y_{04})$

REGISTERED DATA

DATA RECEIVED FROM CPU

OBTAIN DATA FOR COMPARISON WITH ACTUALLY DETECTED COORDINATE FOR AUTHENTICATION BY CALCULATION PRIOR TO AUTHENTICATION

FIG. 11

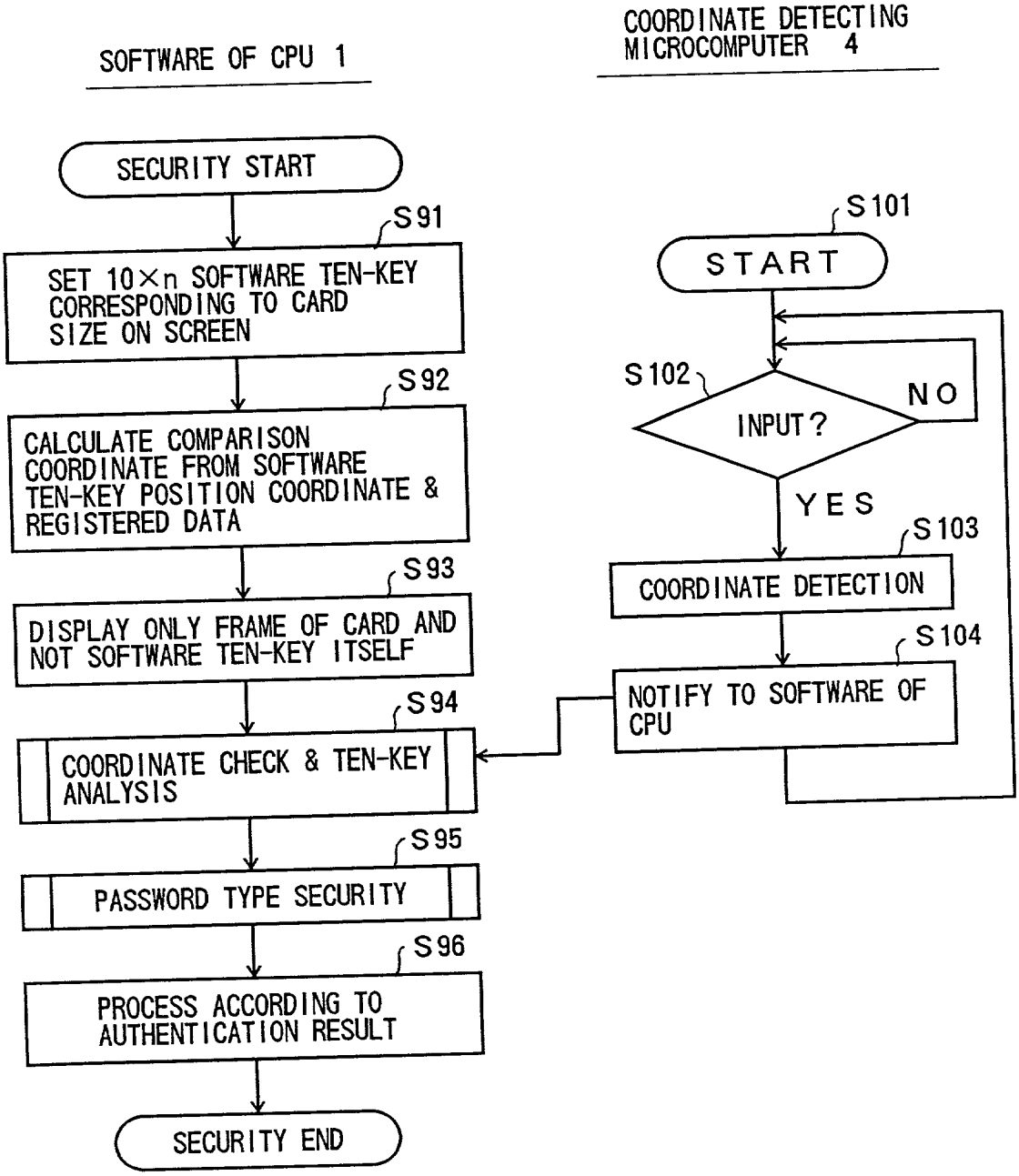
SOFTWARE OF CPU 1
COORDINATE DETECTING MICROCOMPUTER 4
SECURITY START
S91
SET 10×n SOFTWARE TEN-KEY CORRESPONDING TO CARD SIZE ON SCREEN
S92
CALCULATE COMPARISON COORDINATE FROM SOFTWARE TEN-KEY POSITION COORDINATE & REGISTERED DATA
S93
DISPLAY ONLY FRAME OF CARD AND NOT SOFTWARE TEN-KEY ITSELF
S94
COORDINATE CHECK & TEN-KEY ANALYSIS
S95
PASSWORD TYPE SECURITY
S96
PROCESS ACCORDING TO AUTHENTICATION RESULT
SECURITY END
S101
START
S102
INPUT?
NO
YES
S103
COORDINATE DETECTION
S104
NOTIFY TO SOFTWARE OF CPU

FIG. 12A

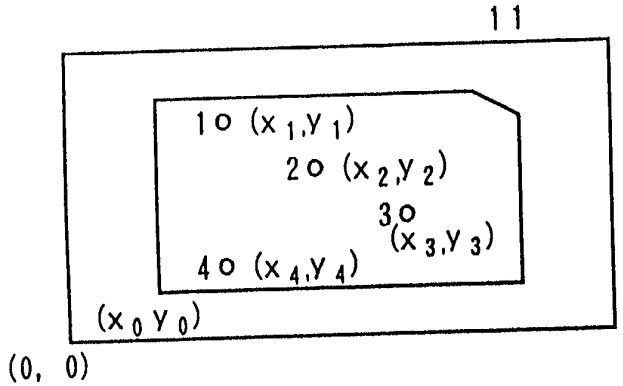

FIG. 12C

POINT	INPUT COORDINATE VALUE
1	(x_1,y_1)
2	(x_2,y_2)
3	(x_3,y_3)
4	(x_4,y_4)

FIG. 12B

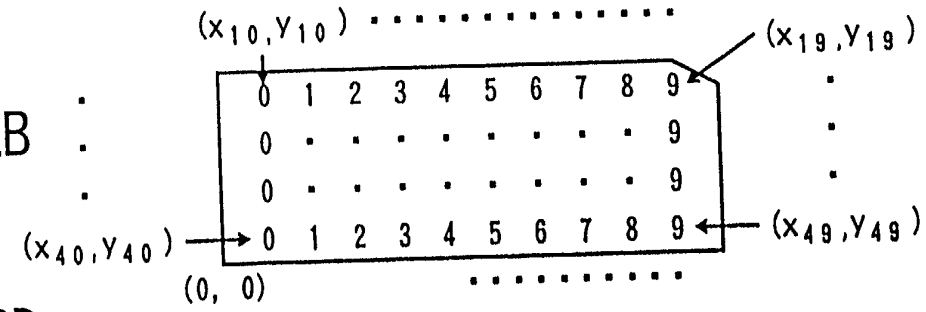

FIG. 12D

POINT No.	RECEIVED COORDINATE	ORIGIN COORDINATE OF SOFTWARE TEN-KEY	COMPARISON COORDINATE OF SOFTWARE TEN-KEY	COMPARISON RESULT	RESULT
1	(x_1,y_1)	(x_0,y_0)	(x_1', y_1') = (x_1-x_0, y_1-y_0)	(x_{12}, y_{12})	2
2	(x_2,y_2)		(x_2', y_2') = (x_2-x_0, y_2-y_0)	(x_{22}, y_{22})	6
3	(x_3,y_3)		(x_3', y_3') = (x_3-x_0, y_3-y_0)	(x_{32}, y_{32})	9
4	(x_4,y_4)		(x_4', y_4') = (x_4-x_0, y_4-y_0)	(x_{42}, y_{42})	2

↓ COMPARE WITH (x_{10},y_{10}) ~ (x_{40},y_{40})

↑

↓ OUTPUT KEY CODE "2 6 9 2"

FIG. 13A

POINT NO.	DETECTED COORDINATE	CARD ORIGIN COORDINATE FROM CPU	COMPARISON COORDINATE OF SOFTWARE TEN-KEY	COMPARISON RESULT	
1	$(x_1\ y_1)$	$(x_0\ y_0)$	$(x_1' y_1') = (x_1 - x_0, y_1 - y_0)$	$(x_{12},\ y_{12})$	2
2	$(x_2\ y_2)$		$(x_2' y_2') = (x_2 - x_0, y_2 - y_0)$	$(x_{26},\ y_{26})$	6
3	$(x_3\ y_3)$		$(x_3' y_3') = (x_3 - x_0, y_3 - y_0)$	$(x_{39},\ y_{39})$	9
4	$(x_4\ y_4)$		$(x_4' y_4') = (x_4 - x_0, y_4 - y_0)$	$(x_{42},\ y_{42})$	2

FIG. 13B

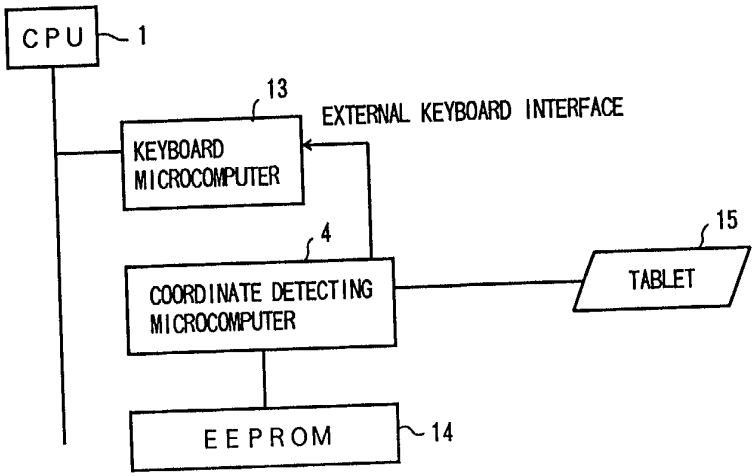

FIG. 14

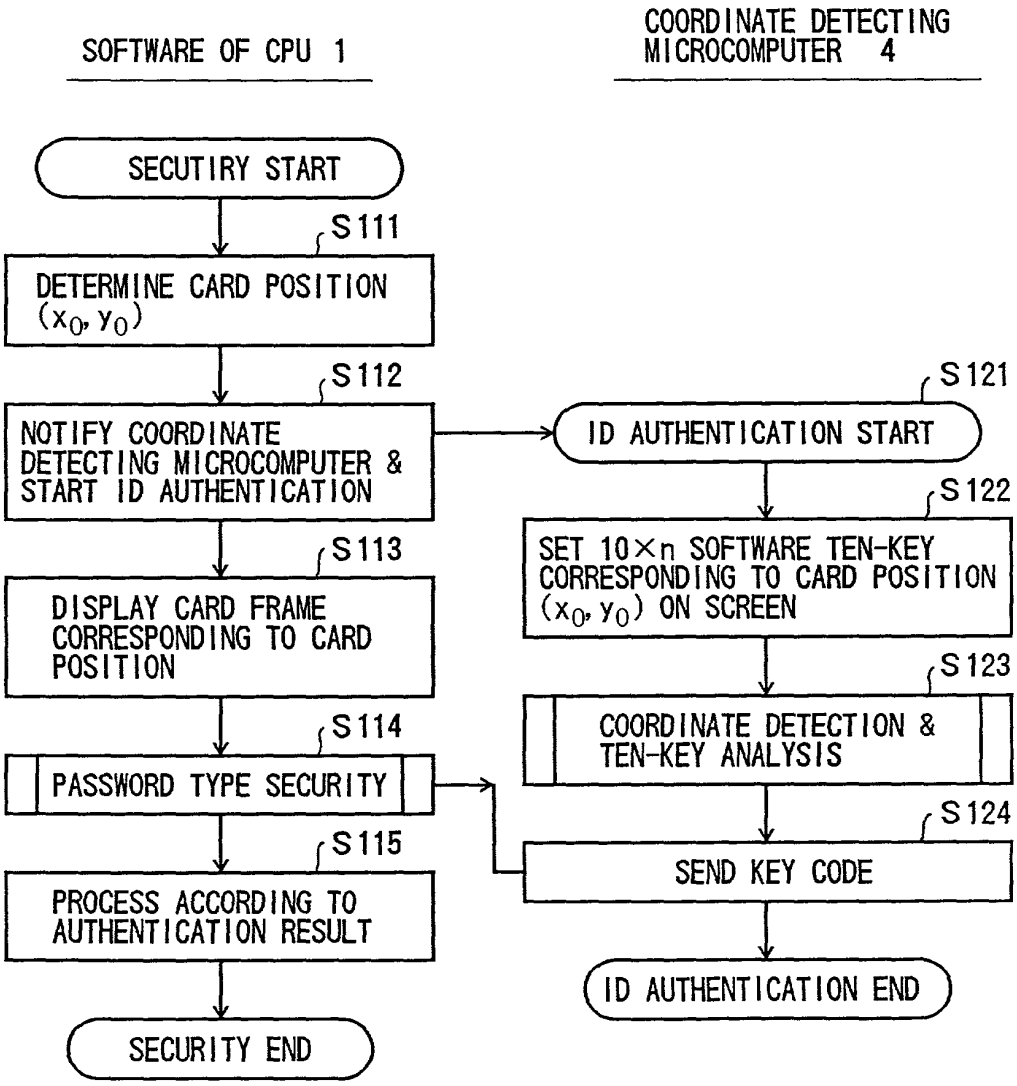
SOFTWARE OF CPU 1
COORDINATE DETECTING MICROCOMPUTER 4
SECUTIRY START
S111
DETERMINE CARD POSITION (x_0, y_0)
S112
NOTIFY COORDINATE DETECTING MICROCOMPUTER & START ID AUTHENTICATION
S113
DISPLAY CARD FRAME CORRESPONDING TO CARD POSITION
S114
PASSWORD TYPE SECURITY
S115
PROCESS ACCORDING TO AUTHENTICATION RESULT
SECURITY END
S121
ID AUTHENTICATION START
S122
SET 10×n SOFTWARE TEN-KEY CORRESPONDING TO CARD POSITION (x_0, y_0) ON SCREEN
S123
COORDINATE DETECTION & TEN-KEY ANALYSIS
S124
SEND KEY CODE
ID AUTHENTICATION END

FIG. 15A

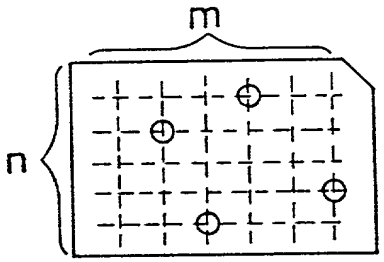

FIG. 15B

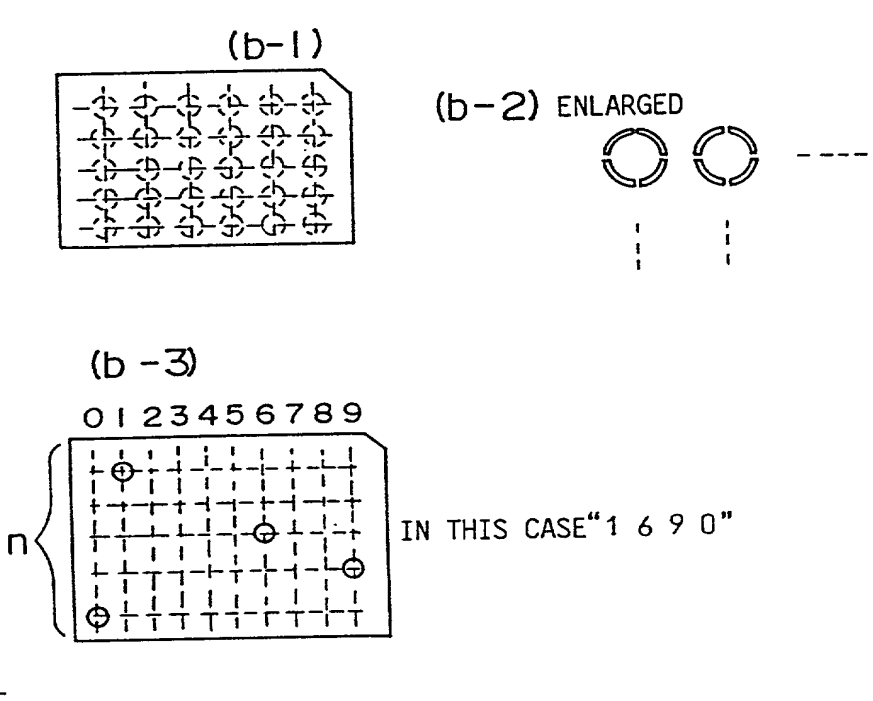

FIG. 16

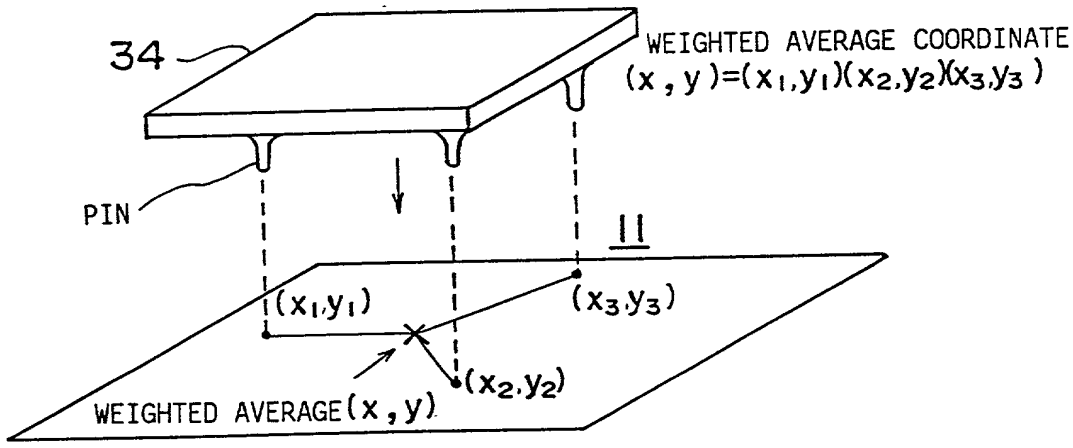
34
WEIGHTED AVERAGE COORDINATE
(x , y)=(x1,y1)(x2,y2)(x3,y3)
PIN
11
(x1,y1)
(x3,y3)
(x2,y2)
WEIGHTED AVERAGE(x , y)

FIG. 17

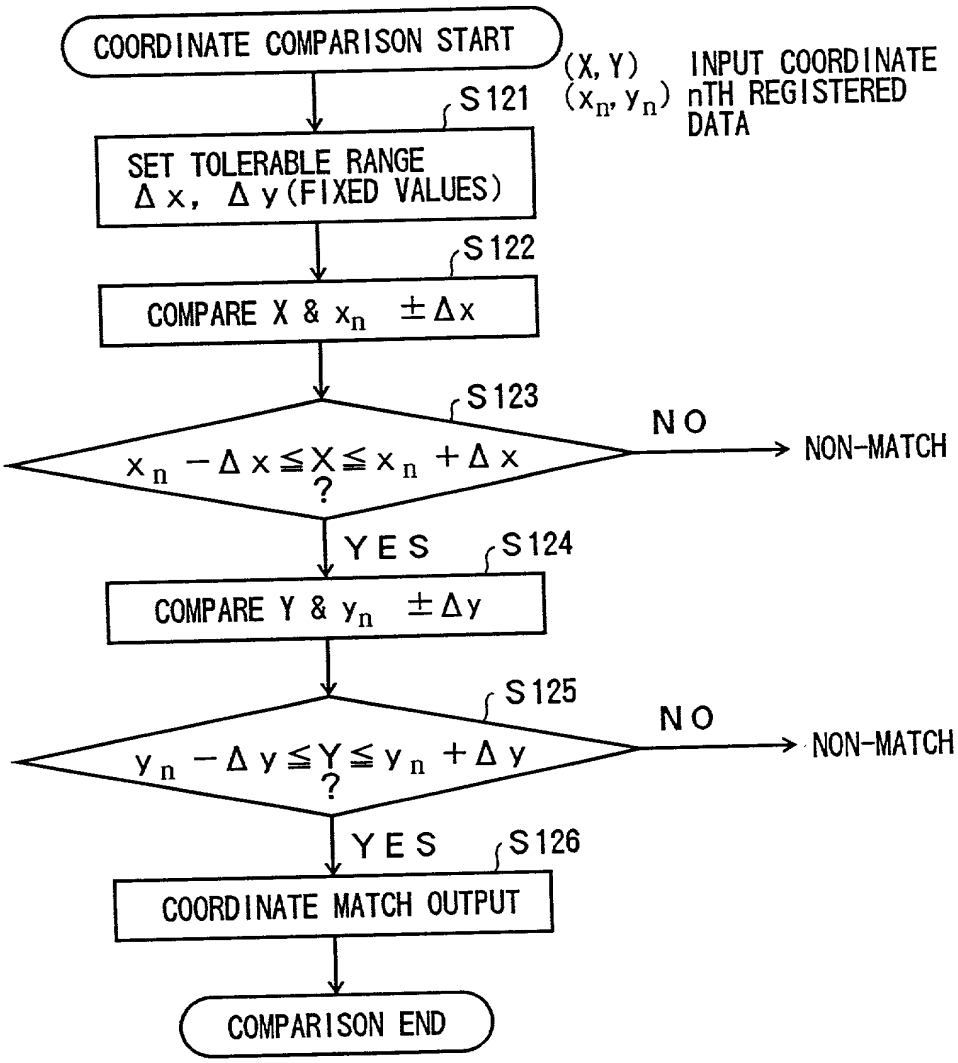
COORDINATE COMPARISON START
(X, Y) INPUT COORDINATE
(xn, yn) nTH REGISTERED DATA
S121
SET TOLERABLE RANGE Δx, Δy (FIXED VALUES)
S122
COMPARE X & xn ±Δx
S123
xn −Δx≦X≦xn +Δx ?
NO
NON-MATCH
YES
S124
COMPARE Y & yn ±Δy
S125
yn −Δy≦Y≦yn +Δy ?
NO
NON-MATCH
YES
S126
COORDINATE MATCH OUTPUT
COMPARISON END

FIG. 18A

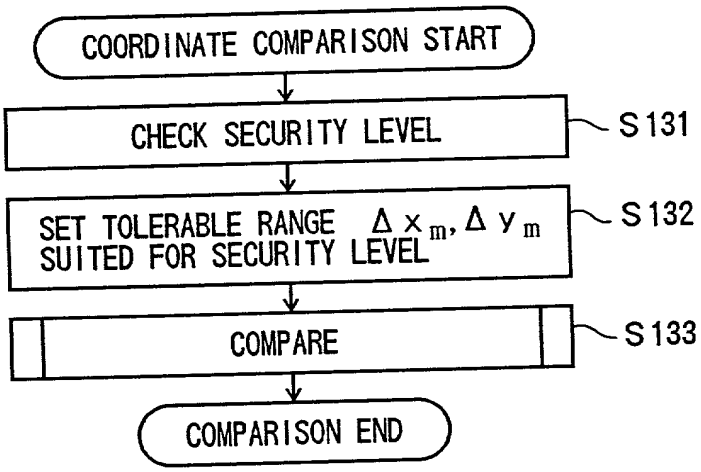

FIG. 18B

SECURITY LEVEL	TOLERABLE RANGE
1	$(\Delta x_1, \Delta y_1)$
⋮	⋮
m	$(\Delta x_m, \Delta y_m)$
⋮	⋮
ℓ	$(\Delta x_\ell, \Delta y_\ell)$

WHERE $\Delta x_1 > \cdots > \Delta x_m > \cdots > \Delta x_\ell$
$\Delta y_1 > \cdots > \Delta y_m > \cdots > \Delta y_\ell$

FIG. 19A

POINT NO.	CARD ORIGIN	REGISTERED DATA OF HOLE COORDINATES WITHIN CARD	COMPARISON COORDINATE RANGE	
			min	max
1	$(x_0\ y_0)$ TOLERABLE RANGE $(\Delta x_0, \Delta y_0)$	$(x_{01}\ y_{01})$	$(x_0 - \Delta x_0 + x_{01},\ y_0 - \Delta y_0 + y_{01})$	$(x_0 + \Delta x_0 + x_{01},\ y_0 + \Delta y_0 + y_{01})$
2		$(x_{02}\ y_{02})$	$(x_0 - \Delta x_0 + x_{02},\ y_0 - \Delta y_0 + y_{02})$	$(x_0 + \Delta x_0 + x_{02},\ y_0 + \Delta y_0 + y_{02})$
3		$(x_{03}\ y_{03})$	$(x_0 - \Delta x_0 + x_{03},\ y_0 - \Delta y_0 + y_{03})$	$(x_0 + \Delta x_0 + x_{03},\ y_0 + \Delta y_0 + y_{03})$
4		$(x_{04}\ y_{04})$	$(x_0 - \Delta x_0 + x_{04},\ y_0 - \Delta y_0 + y_{04})$	$(x_0 + \Delta x_0 + x_{04},\ y_0 + \Delta y_0 + y_{04})$

FIG. 19B

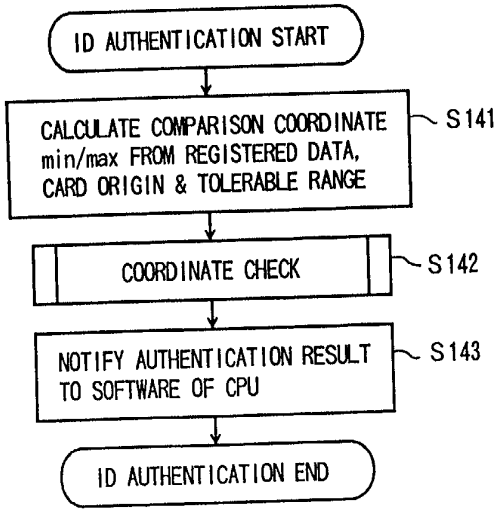

FIG. 20

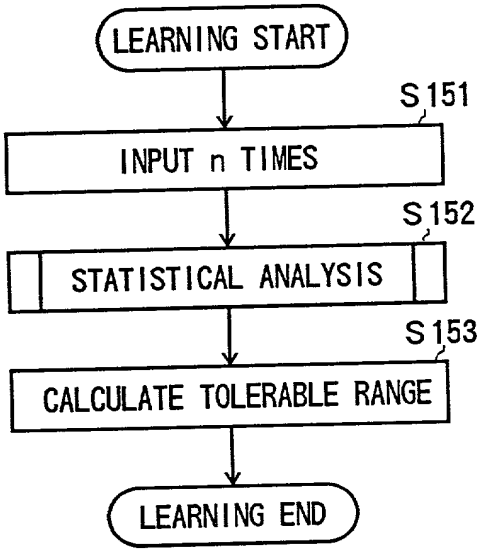
LEARNING START
S151
INPUT n TIMES
S152
STATISTICAL ANALYSIS
S153
CALCULATE TOLERABLE RANGE
LEARNING END

FIG. 21

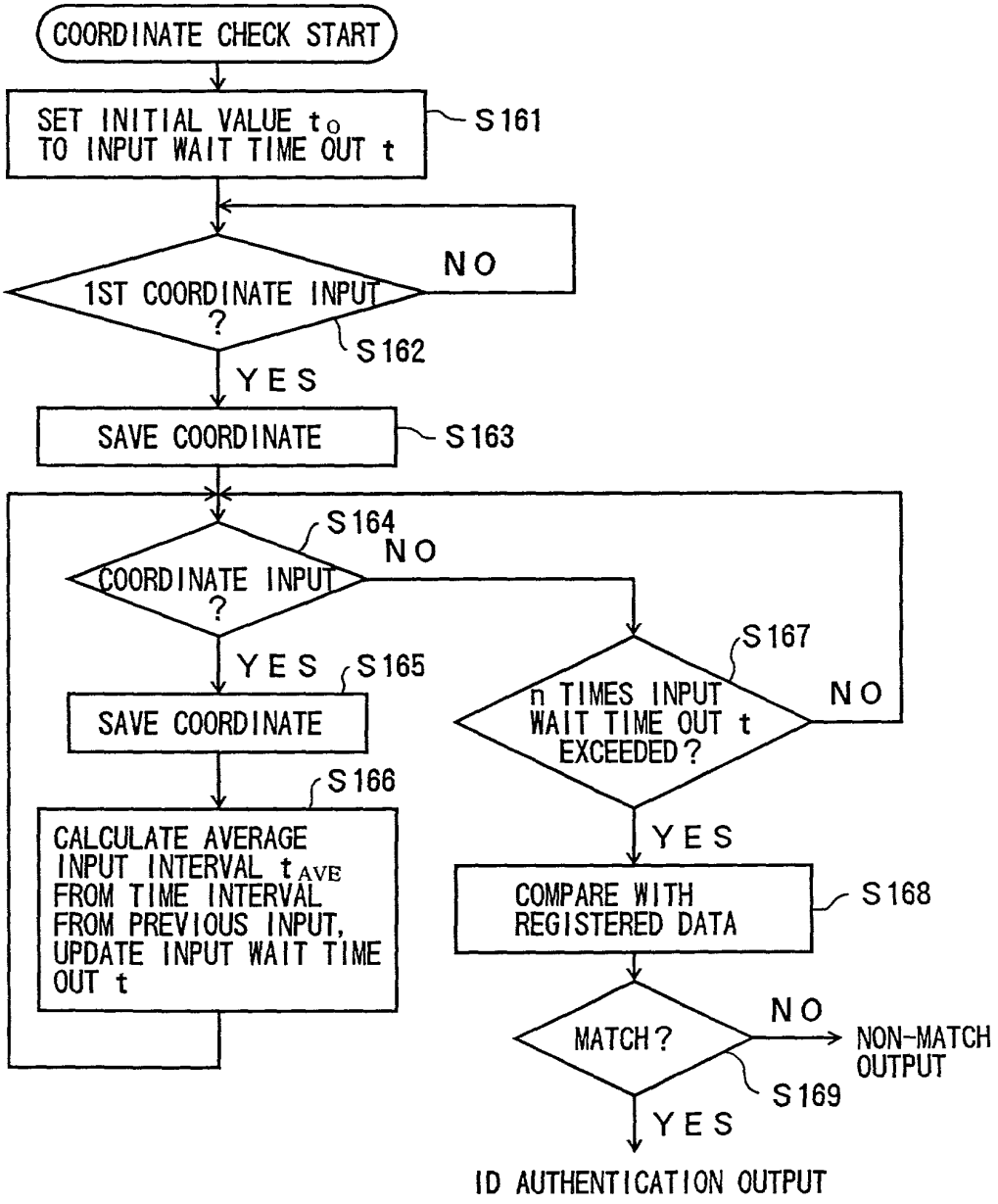
COORDINATE CHECK START
SET INITIAL VALUE t_0 TO INPUT WAIT TIME OUT t
S161
1ST COORDINATE INPUT ?
NO
S162
YES
SAVE COORDINATE
S163
S164
COORDINATE INPUT ?
NO
YES
S165
SAVE COORDINATE
S166
CALCULATE AVERAGE INPUT INTERVAL t_{AVE} FROM TIME INTERVAL FROM PREVIOUS INPUT, UPDATE INPUT WAIT TIME OUT t
S167
n TIMES INPUT WAIT TIME OUT t EXCEEDED?
NO
YES
COMPARE WITH REGISTERED DATA
S168
MATCH?
NO
NON-MATCH OUTPUT
S169
YES
ID AUTHENTICATION OUTPUT

FIG. 22

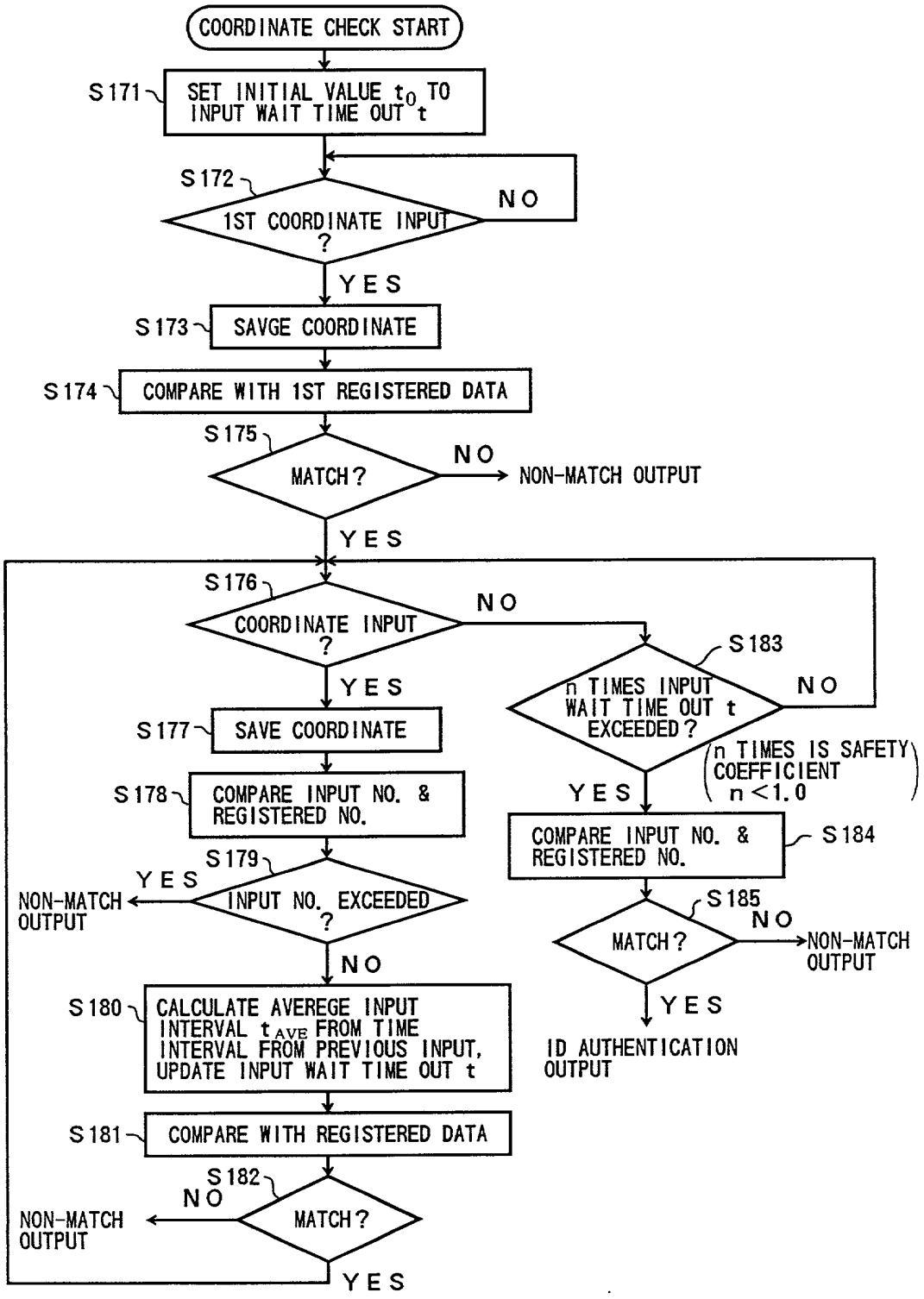
COORDINATE CHECK START
S171
SET INITIAL VALUE t_0 TO INPUT WAIT TIME OUT t
S172
1ST COORDINATE INPUT ?
NO
YES
S173
SAVGE COORDINATE
S174
COMPARE WITH 1ST REGISTERED DATA
S175
MATCH?
NO
NON-MATCH OUTPUT
YES
S176
COORDINATE INPUT ?
NO
YES
S177
SAVE COORDINATE
S178
COMPARE INPUT NO. & REGISTERED NO.
S179
YES
NON-MATCH OUTPUT
INPUT NO. EXCEEDED ?
NO
S180
CALCULATE AVEREGE INPUT INTERVAL t_{AVE} FROM TIME INTERVAL FROM PREVIOUS INPUT, UPDATE INPUT WAIT TIME OUT t
S181
COMPARE WITH REGISTERED DATA
S182
NO
NON-MATCH OUTPUT
MATCH?
YES
S183
n TIMES INPUT WAIT TIME OUT t EXCEEDED?
NO
(n TIMES IS SAFETY COEFFICIENT n<1.0)
YES
COMPARE INPUT NO. & REGISTERED NO.
S184
S185
MATCH?
NO
NON-MATCH OUTPUT
YES
ID AUTHENTICATION OUTPUT

FIG. 23

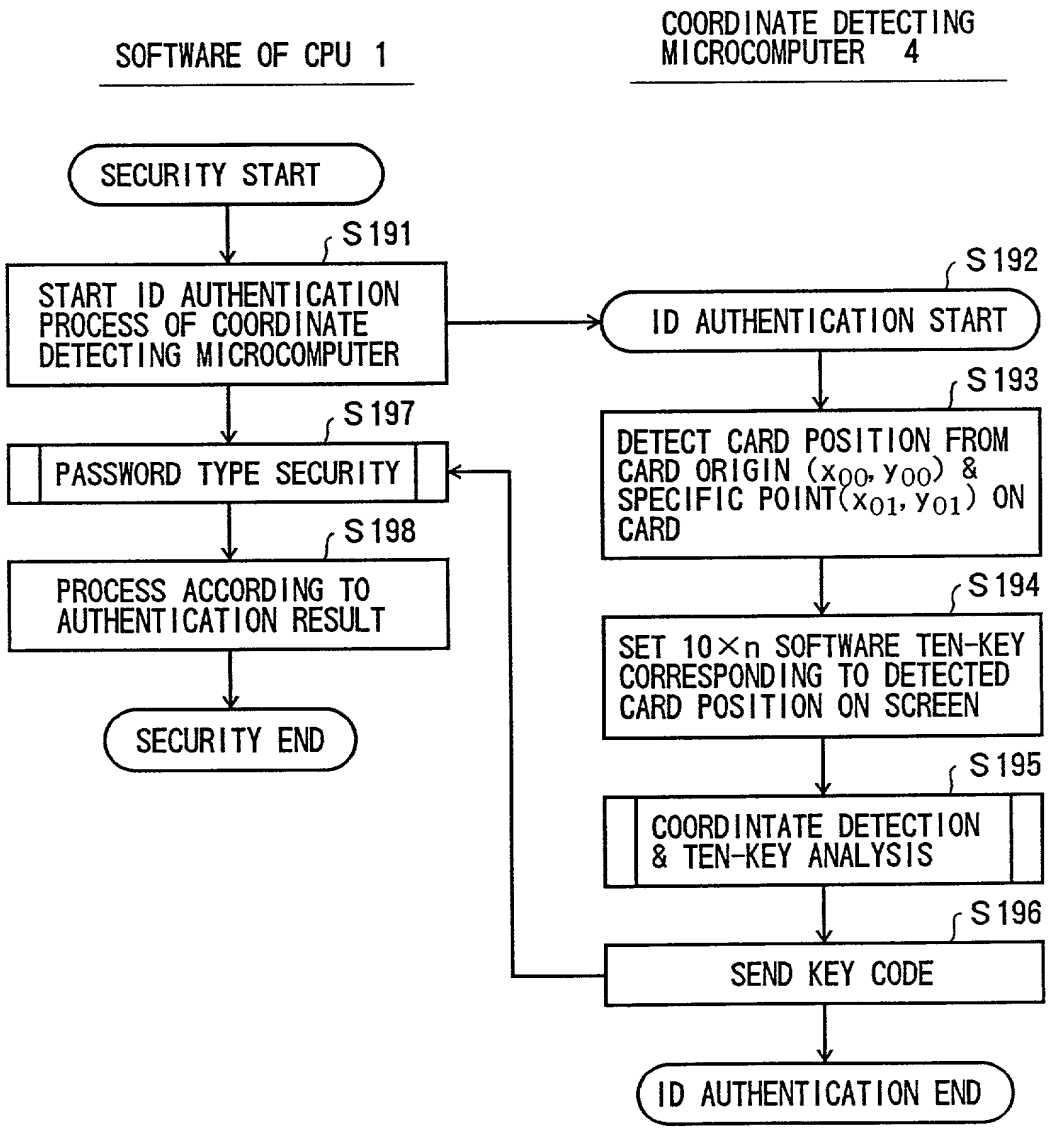
SOFTWARE OF CPU 1
COORDINATE DETECTING MICROCOMPUTER 4
SECURITY START
S191
START ID AUTHENTICATION PROCESS OF COORDINATE DETECTING MICROCOMPUTER
S192
ID AUTHENTICATION START
S193
DETECT CARD POSITION FROM CARD ORIGIN (x_{00}, y_{00}) & SPECIFIC POINT(x_{01}, y_{01}) ON CARD
S194
SET 10×n SOFTWARE TEN-KEY CORRESPONDING TO DETECTED CARD POSITION ON SCREEN
S195
COORDINTATE DETECTION & TEN-KEY ANALYSIS
S196
SEND KEY CODE
ID AUTHENTICATION END
S197
PASSWORD TYPE SECURITY
S198
PROCESS ACCORDING TO AUTHENTICATION RESULT
SECURITY END

FIG. 24A

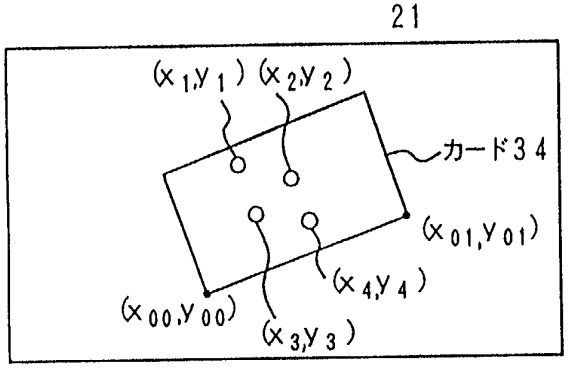

FIG. 24B

POINT DETECTED No.	COORDINATE	CARD POSITION DETECTION COORDINATE	SOFTWARE TEN-KEY COMPARISON COORDINATE	COMPARISON RESULT	NUMERICAL VALUE
1	(x_1,y_1)	(x_{00},y_{00}) (x_{01},y_{01}) $\sin\Delta\theta=\frac{y_{01}-y_{00}}{\ell_0}$ $\cos\Delta\theta=\frac{x_{01}-x_{00}}{\ell_0}$ ℓ_0: DISTANCE BETWEEN POSITIONING HOLES	(x_1',y_1') $=(x_{00}'\ x_1\cos\Delta\theta-y_1\sin\Delta\theta,\ y_{00}'\ x_1\sin\Delta\theta+y_1\cos\Delta\theta)$	(x_{12},y_{12})	2
2	(x_2,y_2)		(x_2',y_2') $=(x_{00}'\ x_2\cos\Delta\theta-y_2\sin\Delta\theta,\ y_{00}'\ x_2\sin\Delta\theta+y_2\cos\Delta\theta)$	(x_{22},y_{22})	6
3	(x_3,y_3)		(x_3',y_3') $=(x_{00}'\ x_3\cos\Delta\theta-y_3\sin\Delta\theta,\ y_{00}'\ x_3\sin\Delta\theta+y_3\cos\Delta\theta)$	(x_{32},y_{32})	9
4	(x_4,y_4)		(x_4',y_4') $=(x_{00}'\ x_4\cos\Delta\theta-y_4\sin\Delta\theta,\ y_{00}'\ x_4\sin\Delta\theta+y_4\cos\Delta\theta)$	(x_{42},y_{42})	2

FIG. 25

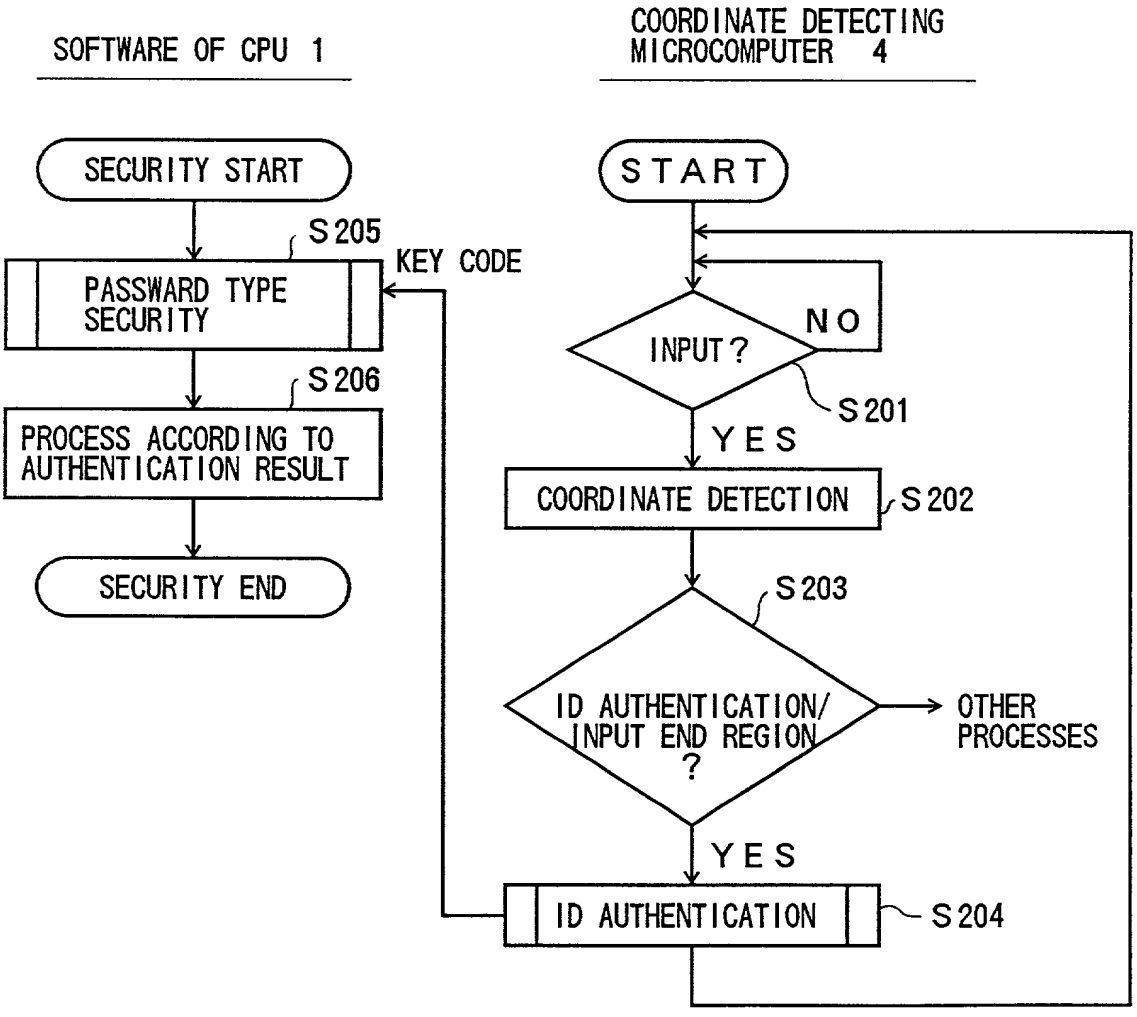
SOFTWARE OF CPU 1
COORDINATE DETECTING MICROCOMPUTER 4
SECURITY START
S205
PASSWARD TYPE SECURITY
KEY CODE
S206
PROCESS ACCORDING TO AUTHENTICATION RESULT
SECURITY END
START
NO
INPUT?
S201
YES
COORDINATE DETECTION
S202
S203
ID AUTHENTICATION/ INPUT END REGION ?
OTHER PROCESSES
YES
ID AUTHENTICATION
S204

FIG. 26

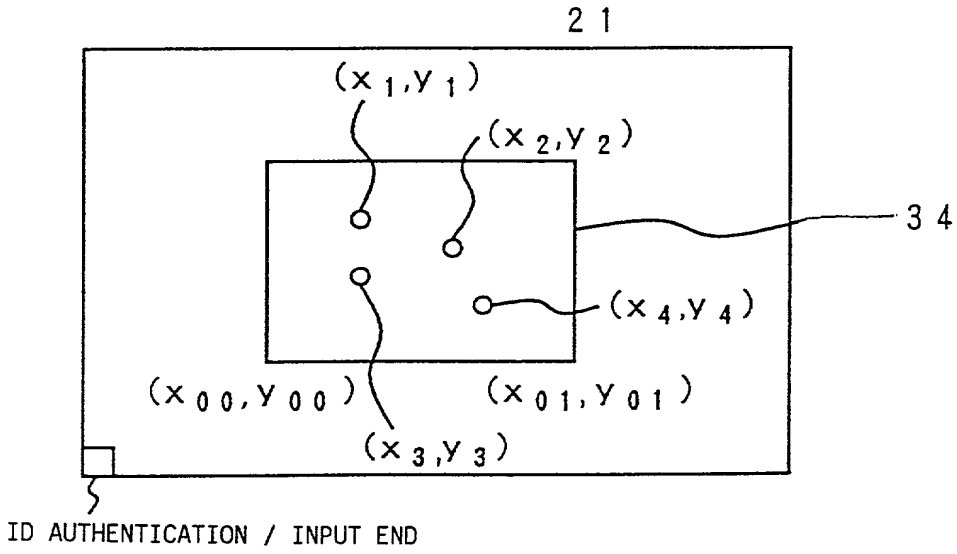
21
(x1,y1)
(x2,y2)
34
(x4,y4)
(x00,y00)
(x01,y01)
(x3,y3)
ID AUTHENTICATION / INPUT END

FIG. 27

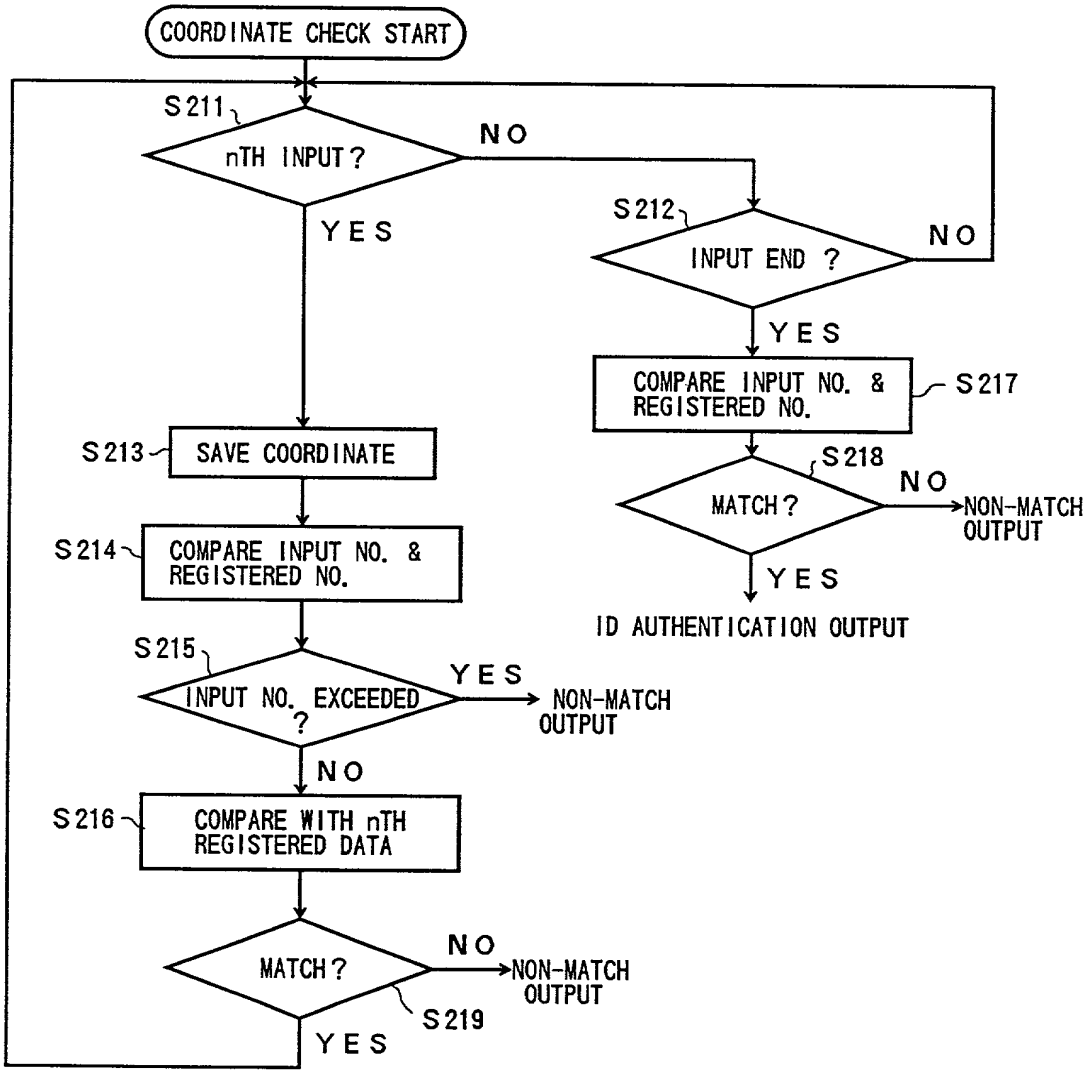
COORDINATE CHECK START
S211
nTH INPUT?
NO
YES
S212
INPUT END ?
NO
YES
COMPARE INPUT NO. & REGISTERED NO.
S217
S218
MATCH?
NO
NON-MATCH OUTPUT
YES
ID AUTHENTICATION OUTPUT
S213
SAVE COORDINATE
S214
COMPARE INPUT NO. & REGISTERED NO.
S215
INPUT NO. EXCEEDED ?
YES
NON-MATCH OUTPUT
NO
S216
COMPARE WITH nTH REGISTERED DATA
MATCH?
NO
NON-MATCH OUTPUT
S219
YES

FIG. 28

POINT NO.	DETECTED COORDINATE	CARD POSITION DETECTION COORDINATE	COMPARISON COORDINATE	REGISTERED COORDINATE	OUTPUT KEY CODE AFTER ID AUTHENTICATION
1	$(x_1\ y_1)$	$(x_{00}\ \ y_{00})$ $(x_{01}\ \ y_{01})$ $\sin\Delta\theta = \frac{y_{01}-y_{00}}{\ell_0}$ $\cos\Delta\theta = \frac{y_{01}-y_{00}}{\ell_0}$ ℓ_0:DISTANCE BETWEEN POSITIONING HOLES	$(x_1'\ y_1') = (x_{00}+x_1\cos\Delta\theta - y_1\sin\Delta\theta,\ y_{00}+x_1\sin\Delta\theta + y_1\cos\Delta\theta)$	(x_1, Y_1)	2
2	$(x_2\ y_2)$		$(x_2'\ y_2') = (x_{00}+x_2\cos\Delta\theta - y_2\sin\Delta\theta,\ y_{00}+x_2\sin\Delta\theta + y_2\cos\Delta\theta)$	(x_2, Y_2)	6
3	$(x_3\ y_3)$		$(x_3'\ y_3') = (x_{00}+x_3\cos\Delta\theta - y_3\sin\Delta\theta,\ y_{00}+x_3\sin\Delta\theta + y_3\cos\Delta\theta)$	(x_3, Y_3)	9
4	$(x_4\ y_4)$		$(x_4'\ y_4') = (x_{00}+x_4\cos\Delta\theta - y_4\sin\Delta\theta,\ y_{00}+x_4\sin\Delta\theta + y_4\cos\Delta\theta)$	(x_4, Y_4)	2

FIG. 29

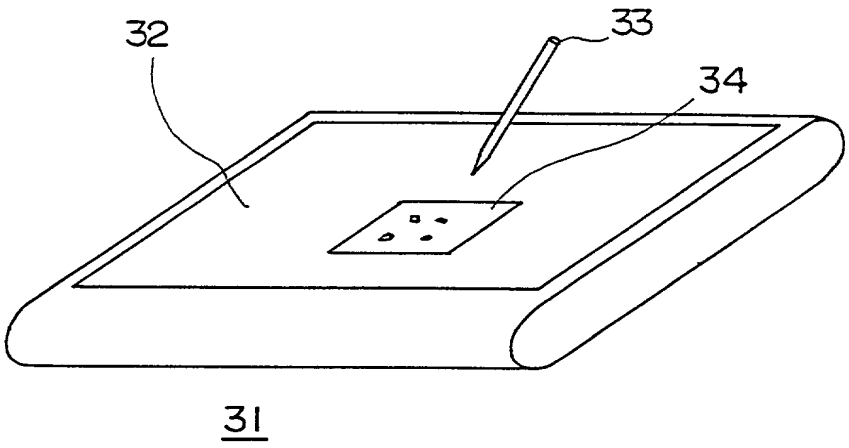

FIG. 30

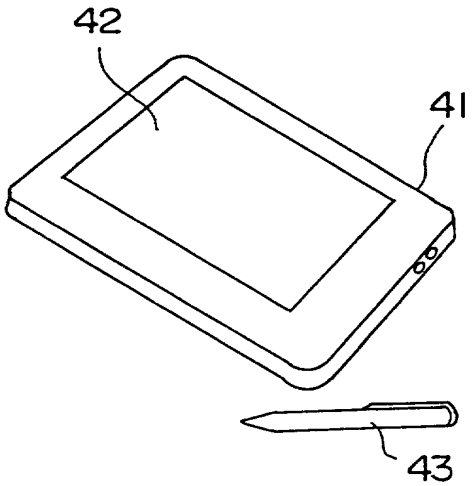

FIG. 31

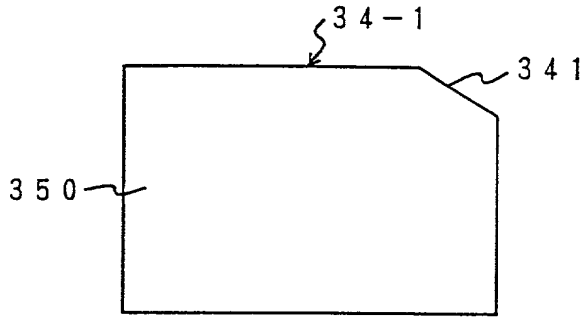

FIG. 32A

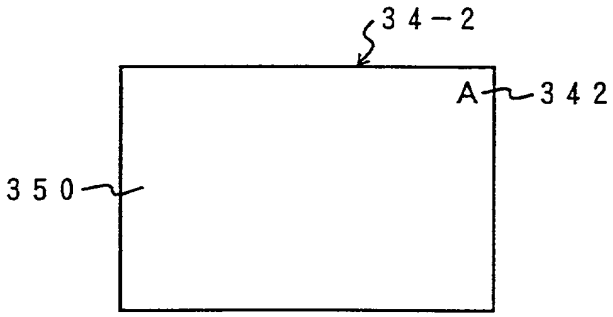

FIG. 32B

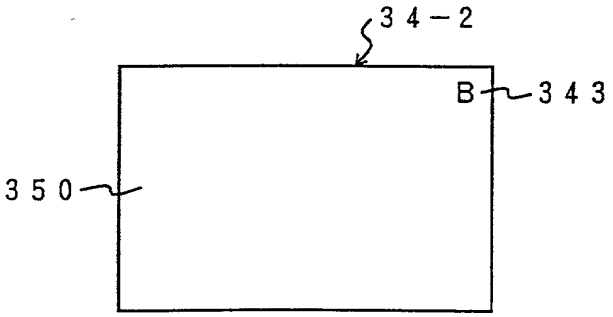

FIG. 33

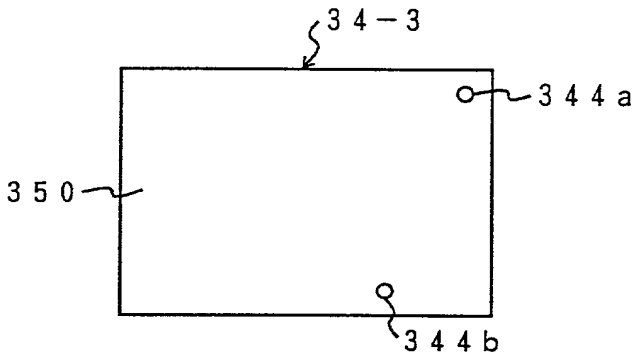

FIG. 34